Criteria for the emergence of economic paradigms

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> "Le jeu du langage est le jeu du monde. Pour saisir le monde, il faut en sortir; et pour sortir du monde, il faut sortir du langage. Mais c'est par le langage que nous pouvons sortir du langage."
>
> Jean Ladrière,
> *L' Articulation du Sens*

Th. Kuhn [1970]'s notion of "paradigm" and the polemic which followed with Popper (see Lakatos and Musgrave eds. [1970]) remained vague enough to allow for any interpretation of the nature of a scientific revolution. The conceptual framework developed by Kuhn for the natural sciences does not seem to fit to the explicative nature of economics. It is no wonder, then, that ambiguity led some historians of economic thought to see revolutions everywhere while others did not see any paradigm (of scientific nature) other than the neo-classic paradigm[1].

Can we leave the framework given by science philosophers, i.e. the alternative "Popper-Kuhn" or "Kuhn-Lakatos" or "Lakatos-Fayerabend"[2], and try to find an epistemology proper to economics, i.e. a sui generis structure for the emergence of theories in scientific revolutions?

Our thesis is that epistemological debates in economics have focused

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[1] A book listed early 20th century, revolutions... Hicks-Ohlin, Samuelson, Chamberlin-Robinson, Tigbergen ... One could believe that all economists are scientific deviants! (see Robertson [1950]). On the other hand, Hutchinson [1977] has not other paradigm since A. Smith, neo-classic one.

[2] i.e. the alternatives to logical positivism — historical relativism research programs — scientific anarchy (see Latsis [1976]).

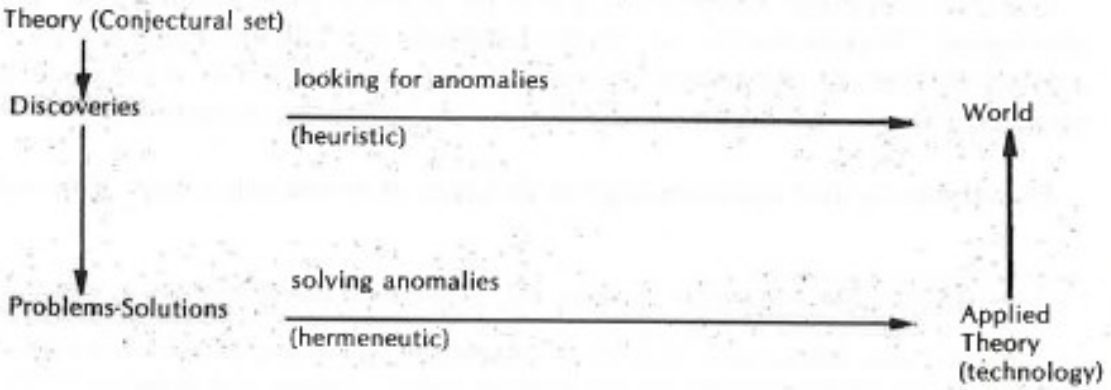
on the discourse's indirect subject matter (the economic models) and not enough on the discourse itself. Since economics is a science directly concerned with "concepts" and not with "facts" (there is no "laboratory" and no research carried out on anything other than the "concept" itself), any criticism must involve a criticism of language. In this direction Schmidt [1985] has made great progress. Our paper aims to give new insights into this analysis.

1. HISTORICAL EMERGENCE OF THE ECONOMIC THEORIES

In the tradition of Nietzche, any history of science becomes deeply materialistic because it takes into account a system generating ideas, their origin and the context of their appearance. This materialistic conception of theories emergence is all the more true in economics because idea development depends on the interests and stakes of the economic and social power. Scientific revolutions in economics — unlike revolutions in the natural sciences — do not only guillotine ideas but also sometimes the men who support them.

Kuhn [1970] defines "normal science" as the identification of significant facts, concordance of facts and theory, and theory's accuracy. It is possible to pose problems and to solve them, which is the very definition of the paradigm. Revolution breaks out when new findings create enigma which the paradigm isn't be able to solve [p. 51].

The scheme of emergence in a natural science is the following:

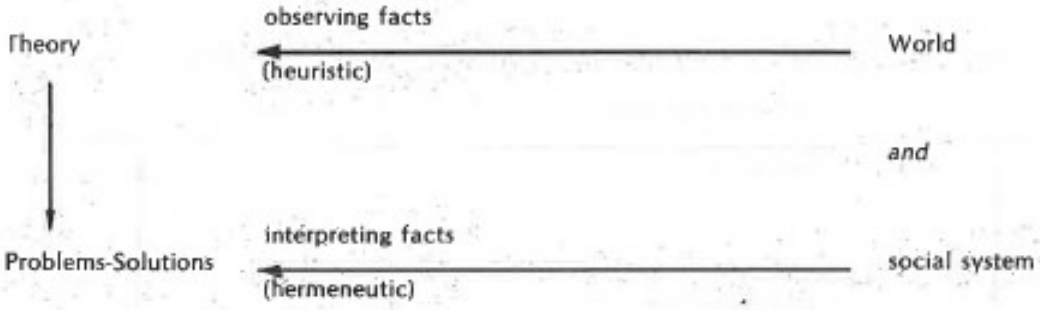


Graph 1 : Emergence of natural science theories

This Technique obviously poses problems but does not question the validity of the underlying theories [G.G. Bohm, et all. [1983]. This explains why the heuristic function of these theories is greater during the "revolutionary" process. However, the hermeneutic function is more important during the interpretation of abnormalities. In fact, the theoretical object remains to be discovered[3].

In the social sciences (other than economics) the choice of paradigm is made by "narcissistic" impulse. Friedrichs [1970] speaks of the "reflection" of one's image in the paradigm of social sciences. The "world" poses its problems and gives its own solutions. As R. Thom put it elegantly: "the predator is his own prey". [p. 56].

Therefore, in social sciences, the scheme emergence of theories is the following:



Graph 2 : Emergence of social science theories

Social background totally influences the theory: social sciences are the "mirror of culture" (F. Von Hayer [1967], Chapter IV). In this revolutionary scheme, the heuristic function is absent: hermeneutic function is the only one that matters since the theoretical object has to be explained and interpreted.

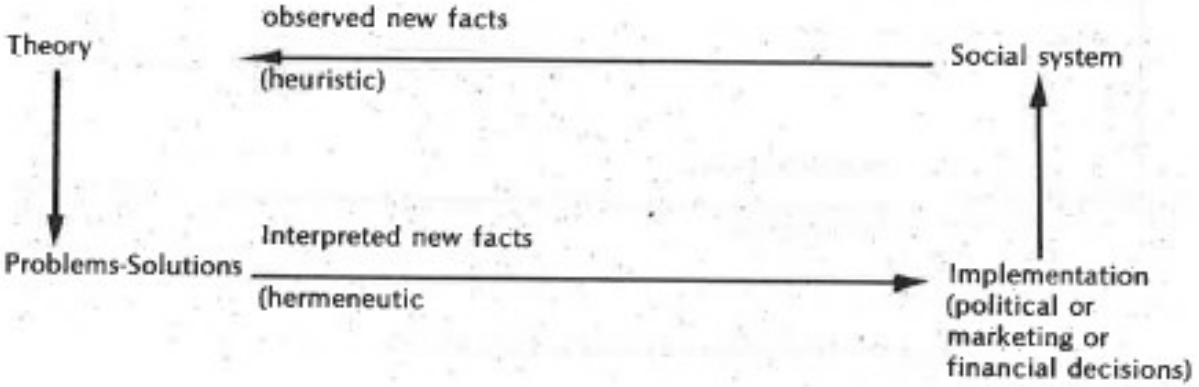
In economics, the emergence of theories is in herently ambiguous because it is both internal and external to the social process. It is external because it is a result of the agent's free choices but is also internal because it is a result of the application of the theories themselves. Hence, it represents the intrinsic relationship between science and world. Of course, some discoveries (infinitesimal computation, linear programing) gave birth

[3]Recall Voon Hayek [1967], (ch. 1)'s distinction between discovering (a new fact or theory), explaining (a fact known theory) and interpreting (an historical fact partially known in theory).

to their corresponding theories but the fact is that real world problems are the origin of economic paradigms.

We can hardly think about mercantilism without the development the international relations, or about Physiocracy without the agrarian economy in France. Concepts such as "General Equilibrium" or "Productivity" were viable only when industrial growth implied overproduction and technical progress. Economic emergence is materialistic (Hicks [1976]). I must point out, however, that changes in the economic world do not automatically lead to a scientific revolution. It is no possible to find a "crucial experiment" (because there is not definite consensus on the falsification criteria) (Blaug [1970], p. 7, Lakatos [1974]), and because of this, theoretical faults do not disturb the axiom's "water-tightness" (a prime example of this would be Leontief's paradox versus Samuelson-Ohlin's theories (De Marchi [1976])).

The emergence of theories in economics looks like this:



Graph 3 : Emergence of economic sciences theories

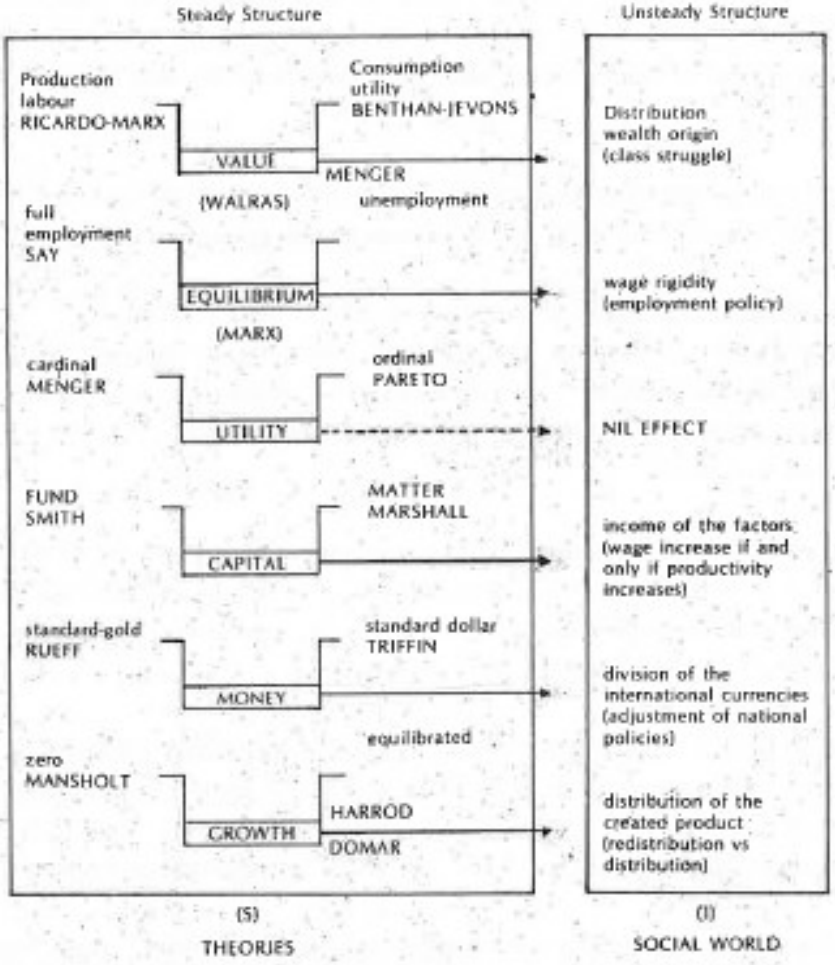
An economic system its problems and delimits its phenomena (heuristic function). An economic crisis will not only engender system bankruptcy but will also question the theories underlying it. The theoretical object has to be found (its uniqueness) and explained (induced by the theory itself). In other words, it has to be interpreted (hermeneutic function)[4]. Therefore, on the one hand the influence of the real world on the theories distinguishes economics from natural sciences and assimilates it to social sciences. On the other hand, the theories' influence on the real

[4]For example, the economist "discovers" the economic consequences of energy on price increase (new fact). He explains the consequences of budgetary deficits on price level (fact known by neo-Keynesian theories). Finally, he "interprets" stagflation a neologism which defines the eco-

world distinguishes economics from social sciences but assimilates it to natural ciences. This is the very definition for the economic knowledge ambiguity and the reason for the economic concept games and economic interest stakes. These are the semantic obstacles and the social stakes.

2. SEMANTIC OBSTACLES: GAMES AND STAKES[5]

The social stakes in the semantics game of economics is summed up, through their corresponding paradigms, by two types of structures: a stable structure where conceptual semantic obstacles seem to be school arguments, and an unstable structure where these issues are more relevant. In the latter structure, scientific economics (theory) influences society and therefore it is not just a game! The following graph shows these structures:



Graph 4: Semantic obstacles in economics

[5]Semantic obstacles are not of the same nature as epistemological ones (as defined in Bachelard [1975]'s epistemology). The former is a linguistic problem, the latter a psychological one.

The stable structure (S) is the framework of (I) exchange development (production-consumption) whereas in the unstable structure we have the consequences of exchange and thus the origin of upheavals in economic theory. In S, scientific upheavals are differentiated according to their aims. These semantic games provoke clashes between different schools.

Value: It gave birth to three schools (two genuine paradigms).

The interpretation of a paradigm influences the distribution of the social product. Their differences are not a mere question of aggregation, as Morishima [1973, 1975] claims. According to Marx, labour value is the basis of the theory of exploitation, i.e. of the revolutionary ethics.

Equilibrium: "Effective demand" (the first obstacle for mercantilists) influences both employment policy and wage policy. This is why Marxist theory sometimes rejects Say's law and sometimes accepts it (Robinson [1971], p. 67).

Utility: The measure of utility does not seem to influence the "unsteable structure". Cardinalists and Ordinalists may go on arguing forever.

Capital: Both conceptions ("capital funds" and "physical capital") are fundamental when it comes to explaining the wage policy. If the "marginal productivity of capital" is not true, as claims the Cambridge School, we'll have to find another way of explaining gain and fair distribution of the social product.

Money: In spite of fashionable theories for which the Third-World countries paid a high price, the issue of the Standard of measures remains an insuperable semantic obstacle for economic theories. The same may apply for international adjustments.

Growth: Just like *money grouwth* has troubled many theoreticians: from those having dreams of the "Golden Age" to those having to deal with the reality of controlling unemployment using more sophisticated techniques (theory of optimal control applied to growth etc.).

Now, what remains of the debate between "positive" and "normative" economics? Given all the semantic stumbling, one may deduce that the theoretical concepts have a meaning within a political framework but that social future defines the economic concepts. This ambiguity becomes a dialetical movement.

3. ORIGINS OF SEMANTIC OBSTACLES

The interdependence between the system and the economic discourse is not the only criterion for the emergence of theories. Indeed, other criteria may help us assess a scientific revolution. These criteria are linked to the theoretical apparatus and they are at the basis for most semantic obstacles: they are the *Weltanschauung*, the types of languages and the dimension of measures.

3.1. THE FIRST SOURCE OF OBSTACLES: WELTANSCHAUUNG

The idea is not new: Schumpeter [1966] wrote more than one thousand pages to demonstrate its role in theoretical conceptualization. Schumpeter, however, in a naive picture of scientific investigation, thinks he can distinguish this "pre-scientific" behavior from the facts observed by the theorician. Mario Bunge [1967b] called this interpretation of conceptualization: "Dataism and dadaism" [p.188].

In fact, vision often impedes to definition of falsification criteria for a hypothesis even though vision becomes one source of "conter-thoughts" (Bachelard [1975], p. 17). It is indeed vision that determines relevant facts to be used as a base to build models (Schumpeter [1949], p. 350). A recent statistical study[6] carried out on 900 economists in different countries shows that their argument is due, to a great extent, to cultural differences as well as different historical and political background (Frey et al. [1984]), which are their "vision".

The juxtaposition of paradigms (Feyerabend [1970], [1975]) is the main feature of economics, it distinguishes economics from the natural sciences. If there is a problem of "income mensurability" in economics, it is precisely one of the consequences of this *Weltanschauung*. The scientist's interpretation is an integral part of the research program and becomes a source of semantic obstacles to the creation of a normal science.

François Perroux [1970] had already pointed out Schumpeter's error: *Weltanschauung* not only makes hypotheses possible but it also *determines* (through a classification of phenomenon) the analytical concepts

[6]FREY et al. [1984].

and the nature of the observations which check these hypotheses. Raw data can only be understood when it makes up part of a *Weltanschauung*[7]. On the other hand, this vision refers to symbolic models as well as value systems or value systems or philosophical systems. The first two economic paradigms (developed by mercantililists) and utopians are prime examples of the *Weltanschauung's* role the emergence of theories.

The first paradigm, developed during a period of trade and geographical expansion, deals with circulation of gods abroad while the second (More's utopia [1946-1974]) deals with wealth distribution. Mercantilism has a materialistic and amoral vision ("altars were raised to gods other than those of religions", wrote E. F. Heckscheer ([1962b], p. 307). Utopia deals more with Platonian values. Mercantilism considers society as a "body" with its needs and its pathologies (it is a symbolic model dating back to Physiocracy). Utopia sees it as, at worst Plato's *Republic* or, at best, Saint-Augustin's *City of God*.

The scientific nature of mercantilist doctrine has not put been questioned by historians of economic thought. Schumpeter, however, was very unfair when he claimed that More got off the "bus of the great economists". Indeed, More not only paved the way for modern socialism (heuristic function) but, above all, it interpreted *by abduction*[8] the first two big semantical obstacles in economic science:

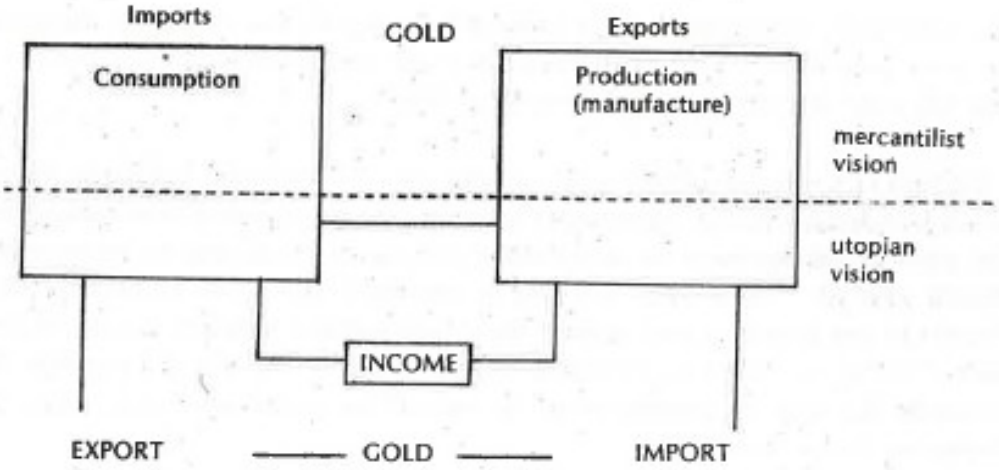
a) the origin of poverty in a society (for example in England) does not lie in social injustice (as Plato believed) but in poor distribution of wealth;

b) unemployment is not a psycho-social plague ("Euclidian postulate" of neo-classicism as Keynes said) but is rather an inherent fault of a social and economic system.

Keynes had only to present these postulats in an *empirical language* to develop, by induction, his theory of income and involuntary unemployment.

We can schematize both mercantilists and utopia's vision in the following way:

[7]The concept of "vision" joins the concept of "hard-core" in Lakatos-type research programs (see Blaug [1970], p. 157, note 127).



Graph 5: Two visions of the same economic World

Even though both More and the mercantilists considered exports as being a source of wealth, their viewpoints differ profoundly: according to mercantilists, export is the *aim* of an economic policy (one produces for export, in exchange for gold for imports and consumption), while for the utopists, export is an *instrument* of economic policy production that creates wealth which in turn makes consumption possible. Only the surplus ofter consumption is exported, wich in exchange for gold, allows basic goods to be imported (More [1916- 1974], pp. 138-140). Utopia is an economy of needs while mercantilism is a market economy.

3.2. *THE SECOND SOURCE OF SEMANTICAL OBSTACLES: LANGUAGES*

3.2.1. *LINGUISTIC REVOLUTIONS*

Heckscher [1962b] wonders how it is possible that such identical visions of society lead to two doctrines as different as mercantilism and physiocracy [p.271]. In order to answer this question, we have to take into account the type of languague of these two paradigms.

The mercantilists' basic statement refers to the existence of a surplus from international trade. However, as Schumpeter [1963] pointed out, they could measure this surplus only using the trade balance. They wanted to measure a quantity using another quantity [p.357]. This methodical approach is not bad (unlike what Schumpeter believed) because it makes it possible to measure what is not observable using observable objects

This method's weakness is that it does not specify the "bridge" between the two concepts[9]. This could hardly have been otherwise since there was no relevant data on international trade.

Physiocrats, on the other hand, could use an empirical language (sweetened by metaphysical statements such as "natural order") because they had date enabling them to make their proposals falsifiable by experiment (Perrot [1978]). They also devised a standard measure invariable with respect to net product and with it, they measured a nation's wealth (Grandamy [1973], p. 28). This example shows that the choice of language determines the type of problems to be solved by paradigms and, thus, the obstacles to be avoided.

Ricardo's theory is another example of linguistic revolution: he felt that they accused him of adopting a new and unused language which could not reconcile with the true principles of science (Ricardo [1817-1977], p. 32). Ricardo wanted to define theoretical and functional terms within a formal (non symbolic) language while seeking an appropriate semantics using "law-likes", i.e. universal laws[10]! According to Stigler [1965], Ricardo's error was that he didn't distinguish between analytical and empirical proposals (p. 330). Quantomania drove him crazy...

It was, however, the "putative father" of modern linguistic Adam Smith [1830-1970] who provoked a true linguistic revolution by introducing social nominalism[11] Adam Smith shifted the focus research from economic systems towards the *meaning* of a conceptual system in Political Economy (value, market, prices, costs, wealth, surplus-value, productivity...) (Sowell [1974], p. 9). He inspired Ricardo's vocation (measures searcher) and Marx's vocation (definitions searcher). However, this meta-theory would have ever have been possible without a meta-language stripped of Physiocrats' empirical constraints.

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[9]Hempel ([1966], p. 96)'s concept of *bridge*.

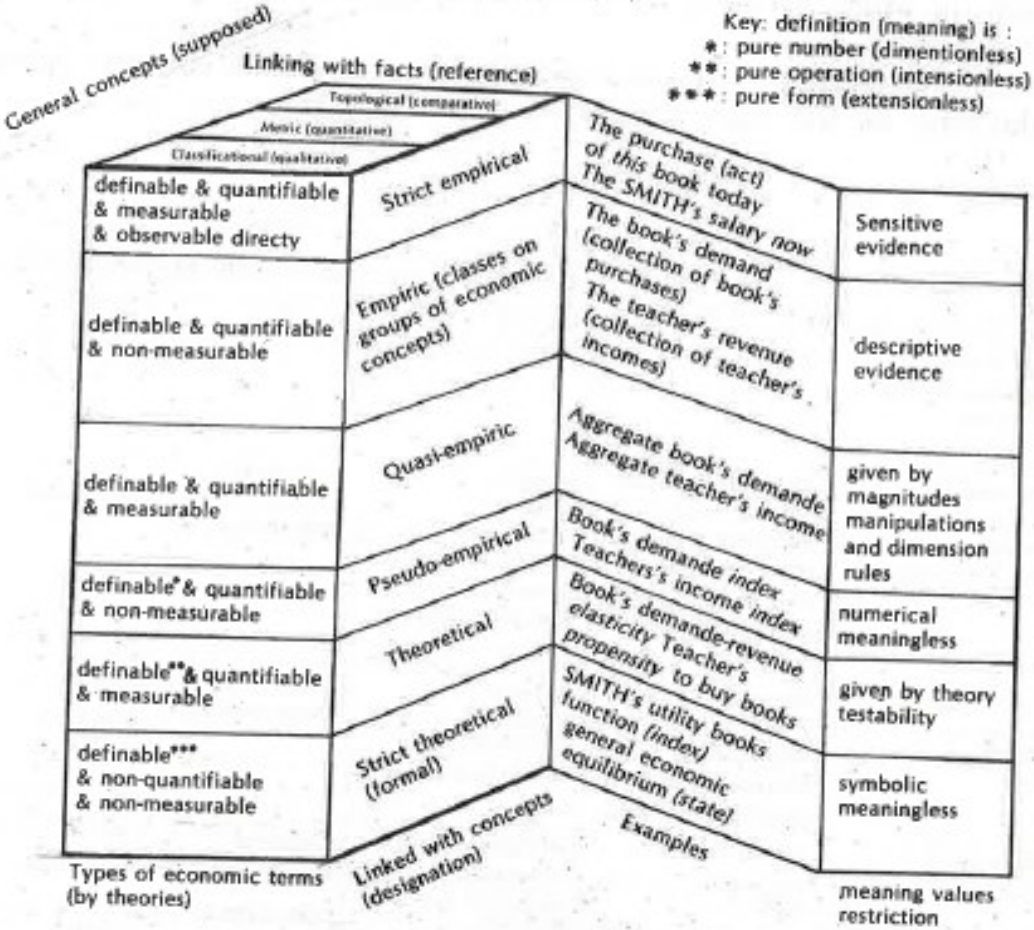
[10]In fact, Ricardo does not respect the conditions for the application of "law-likes". See Hempel ([1965], pp. 264 and suite) for more on "law-likes".

[11]i.e. a nominalism based on social conventions, a kind of instrumentalism (see Lindgren [1969], Largeault [1971] and Saleron [1973]).

3.2.2. TYPOLOGY OF ECONOMIC LANGUAGES

First of all, we have to distinguish, in the scientific languages, *concepts* (linked to reality by "protocolar experience")[12] from *terms* (minimal units of any scientific proposal) and from words (units of natural language).

The following scheme presents a classification of concepts and terms accordding to the type of phenomena, described (inspirated by Carnap [1973])[13]. They were classified according to four bivalent criteria: definable (D), or not ($\bar{D}$), observable (O) or not ($\bar{O}$), quantifiable (Q) or not ($\bar{Q}$) and finally measurable (M) or not ($\bar{M}$)[14]:



Graph 6: Typologie of Economic Language's units and concepts

[12]Margenau [1966], Bunge ([1967a] chapter 2) distinguish between designation (linguistic level) and reference (conceptual level), both relations denote experiment objects.

[13]We obviously add "dialectical" concepts, which are indispensable in economics (see Georgescu-Roegen [1970]).

[14]One term might designate several concepts (for example "freedom" might refer to "political freedom" or "trade freedom") and one concept may refer to several phenomena (e.g. "mechanism"). Bunge ([1967a], ch. 3) has a complete theory on "concept". Also note the difference between theoretical terms and the (formal) signs representing them.

Carnap points out that, on a conceptual level, classification concepts shift toward comparative and quantitative ones with the development. A typical example in economics is the concept of value: using Quesnay's classification between activities which engender value and sterile activities. Smith *compares* costs within an activity ("deer or beaver hunters").

This shift enabled Ricardo to reject value utility (because the only observable data is that wich can be compared after several successive observations) and to propose value-quantity of labour measured in terms of working hours, i. e. production time (Schumpeter [1963], p. 591; Knight [1963], p. 114).

The range going from strictly theoretical terms to strictly empirical terms is the base for the main current economic languages.

TYPE	UNIT	WRITING RULES	RELATIONS BETWEEN UNITS
formal (mathematical economy, microeconomic theories) L_f	symbolical terms	syntactic (formal logic)	analytical
pseudo-empirical (econometric models, macro and micro-economics L_p	theorretical terms defined models or imported from other services Pseudo-empirical and operational terms	syntactic semantic operational (statistical computation) (empirical logic)	probabilistic (frequential or "a posteriori" probability)
quasi-empirical (political economy) L_q	quasi-empirical terms (aggregates) theoretical and operational terms	syntactic semantic operational hermeneutic	causality with "law-likes" or "covering-laws"
dialectical (marxist theories) L_d	modal terms (polysemic) dialectical	hermeneutic dialectical (Regelian logic) syntactic	dialetical (thesis, antithesis, synthesis) cybernetical
empirico-cybernetical (keynesian theories) L_c	empirical and theoretical terms cybernetical terms (interpreted)	semantic (empirical logic) (cybernetical logic)	(interaction/retroaction)

Graph 7: The Structure of Economic Languages

— strictly empirical an empirical terms are units denoting objetcs of experience (singular or classes of objects). They belong to *interpreted languages;*

- strictly theoretical and theoretical terms belong to the *formal languages* (which are not necessarily symbolic). Their semantic value is given by the theory or the model to which they are linked (Nagel [1971], pp 129-152; Hempel [1965], ch. VI);

- when using quasi-empirical terms (aggregates) in an interpreted language, i.e. measurable but non observable "objects", we get *quasi-empirical languages;*

- pseudo-empirical terms result from a computation (operation or assessment on one or several quasi-empirical terms). They belong to *pseudo-empirical languages* which have only the appearance of being an empirical language (e. g. marginal propensity to consume resulting from macroeconomic aggregates);

- dialectical and modal terms belong to *dialectical* languages (marxists) and *cybernetic languages*. The peculiarity of these languages is that they are not compatible with bivalent logic. Mitroff [1973] showed that it was not possible to falsify a theory written in a language (for example L_i) with another theory written in another language (L_e). A third language (an "interpreter") would be necessary but logicians have been seeking it since Wittgenstein ...

3.3. THE THIRD SOURCE OF SEMANTIC OBSTACLES: DIMENSION

3.3.1. DIMENSION AND SCIENTIFIC REVOLUTION

Cambridge criticism based its arguments on three different types of problems: the measure of a class of objects (physical capital), the bridge between observable and non-observable objects and the link between simple (micro) structure and complex (macroeconomics) structures. The first problem is additivity, the second: testability and the third: derivability (of the laws of one structure from another). These three problems are also found in physics with is heterogenous magnitudes and their possible concatenation. Physicists use the concept of "Dimension", which they distinguish from the quantity and name of a magnitude (Berka [1983], p. 66; Bunge [1967b], ch. XIII). Therefore, dimension is not a mere numerical or linguistic characteristic.

a) Fourrier sees dimension as a link between numerical values of basic magnitutes (e.g. lenght) and deriv magnitudes (e.g. distance) when mea-

suring units have a different size. This implies that the definition of a magnitude dimension must preced the determination of its measuring units (Berka [1983]).

(What is the dimensional link between a sewing machine in a workshop and the computer in a multinational company? At what basic magnitude are they similar?).

Ricardo's methodology, which found a common and fixed measure for capital, led him to a physical magnitude: the quantity of working hours. In the "General Theory", Keynes said he hesitated with three problems: quantity units, the role of prediction and the definition of income, to such a extent that he remained unable to express himself correctly before having found solution (Keynes [1935-1971], p. 59). He chose employment and wage as basic magnitudes.

Because employment is measured in working units, i.e. "an hour of ordinary working force" (p. 63), it belongs to the temporal dimension. Derivated magnitudes (capital marginal efficiency, use-cost, ...) also belong to this temporal dimension. It is through the marginal efficiency of capital that the "prediction of the future influences the present ... and the existence of durable equipment links future economics to present economics" (pp. 158-159). Wage being measured in terms of wage units (money), belongs to the money dimension. Derived magnitudes (consumption, savings and investment, ...) also belong to this dimension. Because they are families of magnitudes (having the same dimension), measuring units change size without violating the "invariance laws"[15] Keynes can add "working hours" or consumption which would not have been possible in terms of volume (physical dimensions).

Does this allow us to speak of same supply and demand curve for Keynesian or Neo-Classic economics?

If, like Hicks [1937], Hansen [1953], Roberts [1984] and others, today we measure these magnitudes in terms of product quantity not in nominal income, we can conclude that these measures do not belong to the same dimension. What is worst, if income is measured in real terms (physical magnitudes whose dimensions are: mass, lenght, time, ...) and not in nominal terms, one should specify in which physical dimension employment is measured. Keynes found the "bridge" using income (A-U) simul-

[15](Berka [1983], p. 60) Note, however, that Keynes — like Ricardo — made a logical feat of strenght obliterating the issue of qualified work.

taneously measured in a money dimension (A : production value) and a temporal dimension (U = updated cost). If income is "concatenable" to employment (measured in terms of working time), and if it is additive, it is because wage units wander in a temporal and monetary dimension[16]. In other words, dimension is a condition for additivity of measuring units. Note that dimensions are basically the qualitative feature of a magnitude, only the numerical values of magnitude are added.

An example may help us to understand the scope of this observation. Since individual incomes belong to the same dimension (money), one can add their numerical values to get the national income, which does not have the same meaning (denotation and connotation) as individual income. Unlike physical addition, it is an addition of monetary units. According to Georgescu-Roegen [1970]'s terminology, it is an "external addition" [P. 57]. In other terms, an aggregate represents for an object which is different from its components. Either an elephant is only the sum of its chemical components (and whether it is dead or alive does not matter) or he is different and whether it is dead or alive does matter[17]!

b) Menger[18], inspired by Helmholtz and Newton, proposes another interpretation of dimension. From the Newtonian concept of fluent (a quantity whose empirical value varies), Menger thinks that dimension is the dependence of derived measuring units o basic measuring units, basic magnitudes.

Let, for example, T be the action of looking at one's watch (graduated in seconds) and T_t be the result of this observation (the number on the watch). The class of even numbers (T, T_t) corresponds to the *fluent* t (time in seconds) whose empirical value is T_t (no seconds, 37 seconds,...) [p. 108]. It is possible to set a functional relation between one or several *fluents*. The number of classes of *fluent* (independent) we can associate determines the dimension[19].

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[16]This explains why Keynes considers that real income has no influence on employment while nominal income (through the propensity to consume, the marginal efficiency of capital or the interest rate) on effective demand (See Robinson ([1971], chap. X), Fender [1981], chap.2).

[17]Note that in physics only basic magnitudes are additive (Berka [1983], p. 77).

[18]K. Menger, Mensuration and other mathematical connections of observable materials, in Churchman-Ratoos H. ([1962], pp. 97-128).

[19]Consider it to be a relation between an empirical action (watching) and a number.

Cartesian coordinates are the more trivial example of the bidimensionality of numbers (and not of *fluents* which are, once again, empirical objects).

Now let u be the utility of an orange for an individual (measurement to be determined). (O, uO) determines the *fluent* of u (of oranges for this particular person) whose empirical value is uO (note that this is a subjective *fluent* in Menger's terminology [p. 109]). Let p be the price of the oranges (measured in francs). (O, pO) defines the *fluent* of the price of oranges (objective *fluent*). Finally, t be the work quantity (measured in time) needed to make oranges available on the market. (O, tO) defines the *fluent* of the quantity of work.

Can we link these three *fluents* during the purchase of an orange in such a way that vO = F (uO, pO, tO): v being the *fluent* of "the value of an orange"? This is obviously impossible since the *fluent* v would be a function F of three *fluents* belonging to different dimensions (psychological, monetary and temporal). To link these three *fluents* we have to specify the kind of coordination which exists between the fields of the *fluents* u, p and t[20].

The problem of the transformation of value into prices is only one example, among others, of our analysis. One of Marx's main error was to believe that values are observable (just like prices). Morishima [1973] pointed out this duality in Marxist theory and Bortkiewacz showed that it was impossible to observe (Marxist) value using price systems (Desai [1974]).

Samuelson tried to eliminate this duality by reducing the issue of a "fourth dimension" to a matrix of technical coefficients. Except for his self-imposed restrictive hypothesis, Samuelson carefully avoided specifying how he measures and how he succeeds in aggregating magnitudes of apples and magnitudes of computers. His "output-value" is only a paper elephant!

In other words, unless we see the value of a purchase as a multidimensional measure and dimension as being coordinated according to the simultaneity principle, we have to accept that the problem remains wide open (unless we chose one dimension or the other, as Keynes and Marx did). But

[20]For example, temperature (t) of a simple gas (g) is a function (F) of pressure (p) and the volume (v), identified by coordination tg = F(pg, vg).

even if this problem is solved, we'll still have to agree that these *fluents'* empirical content, i.e. their testability decreases with their aggregation level because of "aggregation bias" (Theil [1954]).

c) For Maxwell, dimension determines the relation between simple and complex magnitudes. But in economic theory, the link between axiomated microeconomics and a Keynesian macroeconomics which could derivate from it, also remains an open issue (Weintraub [1979], Boland [1982]).

The bridge between microeconomics to macroeconomics, i.e. from a "micro" dimension to a "macro" dimension, obviously poses the problem of consistence between the basic postulates of microeconomics theory and the results of macroeconomic observations.

The dilemma is the following: either "macro" dimension represents the same (an aggregation) as the laws "micro" dimension (but not all the laws so there is a "quantitative residue") or it represents other laws (and the individual agent's behavior remains an enigma for theoreticians). In other terms, we are dealing here with the question of a theoretical reduction which could enable us to test theoretical laws of one field (microeconomics) using the empirical laws of another field (macroeconomics). This is only possible if there is an isomorphism between these laws (Nagel [1971][21].

Now, this issue of the dimension of the phenomena to be explained underlies not only the theories of Walras, Keynes and Marx but also of Katona, Renaud, Debreu, Koopmans, Perroux, Dupriez, Kuznets, ..., i.e. virtually the whole history of economic thought.

The most striking example is that of Fisher [1969]. White trying to find evidence for the aggregate production function, he came up with a paradoxical conclusion for a neo-classic: work can be aggregated only if there is a single comparable measure for specialized tasks (p. 566). In the other words Morishima rejects the Marxist theory of value because he finds it useless; Fisher confesses the need for a single measure of work to ... be able to aggregate it!

[21]Georgescu-Roegen [1965] showed that it was impossible to reduce to a binary mathematical model (using Aristotle's excluded tiers). Marx's analysis of the process of capitalistic development, which on the continuing absorption of human energy.

CONCLUSION

An analysis of the economic discourse showed us that scientific revolution emerges from the state of the world but, above all, from the perception, concept and measures chosen economists to develop their theories.

An economic epistemology cannot lead to a thorough interpretation using esoteric paradigms (because of the language games), esoteric programs (because the vision range is not exclusive), or a simple juxtaposition of paradigms (because their dimension is divergent).

Perhaps, we should accept, more as an obligation than as Sisyphusfate, that the epistemological darkness surrounding economic knowledge is the tribute we have to pay for economics being a human science. Vision's polychromy character, language games and dimensional ubiquity demonstrate that even though economics is a science, it can only be a science of life. Paraphrasing Hegel, life has no identity.

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